Appendix A

Model parameterization (input data) details:

a) **Digital elevation model** – United States Geological Survey National Elevation Dataset
b) **Stream channel network** - USGS National Hydrography Dataset (NHD)
c) **Landcover** - USGS 2001 National Land Cover Dataset
d) **Soil types** – Natural Resource Conservation Service State Soil Geographic Database
e) **Weather** – National Oceanic and Atmospheric Administration National Climatic Data Center and Michigan State University's Michigan Climatological Resources Program; daily precipitation, minimum and maximum temperature, windspeed, relative humidity, and solar radiation for 150 local weather stations.
f) **Point source discharges** - EPA Permit Compliance System (PCS) database, supplemented when necessary with averages from more complete local discharger datasets; average daily water flow, total suspended solids (sediment), organic phosphorus, organic nitrogen, nitrate, ammonia, nitrite, soluble reactive phosphorus (mineral phosphorus), chemical/biological oxygen demand, and dissolved oxygen data.
g) **Impoundment characteristics** - Allan and Hinz (2004); USGS National Hydrography Dataset; surface area and volume measurements for typical and flood stage conditions were collected. Impoundments located on stream channels, including natural lakes and artificial reservoirs, were included in the SWAT models. Impoundments with surface areas > 50 ha were incorporated into SWAT as reservoirs, and impoundments of 10 - 50 ha were incorporated as ponds. The impoundment outflows were estimated based on the targeted release option which allows some extra filling of impoundments during flood events, followed by return back to volume at principal spillway depth within a few days. When multiple ponds or reservoirs were located in a single subwatershed, the surface area and volume were summed since SWAT only accepts one pond and one reservoir per subwatershed. Water quality parameters to depict P and N settling in impoundments were adjusted on the basis of a study of 27 Midwestern reservoirs (Walker and Kuhner, 1978) that reported median settling rates of 14.0 m/y for P and 4.7 m/y for N. All other reservoir and pond input parameters were set at default values.
h) **Atmospheric N deposition** - National Atmospheric Deposition Program (NADP); unique N concentration used for each watershed.
i) **Land management practices** - USDA National Agricultural Statistics Service (NASS), various local experts, and Ruddy et al. (2006); generalized land management schedules (operations include fertilizer application, tillage, crop planting/harvesting, and manure application) applied to each watershed uniquely.

Allan JD, Hinz L. An assessment of flows for rivers of the great lakes basin. Project report prepared under grant from Great Lakes Protection Fund. Ann Arbor, MI. 2004.

Ruddy BC, Lorenz DL, Mueller DK. County-level estimates of nutrient inputs to the land surface of the conterminous United States, 1982-2001. National Water Quality Assessment Program, U.S. Geological Survey. 2006.

Walker WW, Kuhner J. An empiracal analysis of factors controlling eutrophication in midwestern impoundments. In: International Symposium on the Environmental Effects of Hydraulic Engineering Works, University of Tennessee, Knoxville, TN. 1978.

Model calibration and validation details (from Bosch et al., 2011)

Model calibration included several sequential stages for each individual watershed, including hydrology sensitivity analysis, hydrology manual calibration, hydrology autocalibration, sediment manual calibration, and nutrient manual calibration. First, an automated sensitivity analysis (Van Griensven et al., 2006) is carried out through the ArcSWAT interface with hydrologic model parameters in order to identify the parameters to be adjusted during the autocalibration procedure as well as to give some insight into parameters to adjust during manual hydrology calibration. The sensitivity analysis procedure uses the Latin hypercube one factor at a time design, and identifies the top 15 most sensitive parameters. Next, the hydrology was roughly calibrated manually by changing sensitive hydrologic parameters as described in Santhi et al. (2001). Once simulated stream discharge roughly fit the observed discharge for the calibration time period, a second sensitivity analysis was performed. The top 15 parameters of both the pre- and post-manual calibration sensitivity analysis runs were then used for the hydrology autocalibration. The hydrology autocalibration employed the PARASOL calibration procedure included in the ArcSWAT interface (Van Griensven and Meixner, 2007). The PARASOL method applied a shuffled complex evolution optimization scheme to select the optimal parameter value set for the 15 sensitive hydrologic parameters after several thousand model runs. The calibration was based on monthly observed USGS daily mean stream discharge data (1998-2001) and SWAT simulated stream discharge. Hydrologic model parameter values were then adjusted to reflect the optimal value set chosen by the autocalibration process.

After model hydrology calibration was completed, manual calibration of sediments and nutrients was completed, followed by model validation. SWAT sediment parameters were calibrated following the procedure of Santhi et al. (2001) based on monthly observed sediment loads from 1998-2001. Since no observed sediment data were available for the Huron River, the optimized sediment parameter values from the adjacent Raisin watershed were used for the Huron SWAT model as well. After sediment calibration was completed, TP, SRP, TN, and nitrate calibration was done based on monthly observed nutrient data (Santhi et al., 2001). SWAT output included mineral P and other P, so SWAT mineral P was compared to observed SRP data and observed TP was compared to the sum of SWAT mineral P and other P. After model nutrient parameters were optimized for all six watershed models, calibration was complete and model validation was initiated. During model validation, evaluation statistics were calculated for stream discharge, sediments, TP, SRP, TN, and nitrate and for each of the six SWAT models (Moriasi et al. 2007), but no further model parameter changes were made.

Bosch, N.S., Allan, J.D., Dolan, D.M., Han, H., Richards, R.P. 2011. Application of the Soil and Water Assessment Tool for six watersheds of Lake Erie: Model parameterization and calibration. J. Gt. Lakes Res. 37, 263-71.

Moriasi DN, Arnold JG, Van Liew MW, Bingner RL, Harmel RD, Veith TL. Model evaluation guidelines for systematic quantification of accuracy in watershed simulations. Trans ASABE 2007;50:885-900.Santhi C, Arnold JG, Williams JR, Dugas WA, Srinivasan R, Hauck LM. Validation of the SWAT model on a large river basin with point and nonpoint sources. J Amer Water Resour Assoc 2001;37:1169-88.

van Griensven A, Meixner T. A global and efficient multi-objective auto-calibration and uncertainty estimation method for water quality catchment models. J Hydroinformatics 2007;9:277-91.

van Griensven A, Meixner T, Grunwald S, Bishop T, Diluzio A, Srinivasan R. A global sensitivity analysis tool for the parameters of multi-variable catchment models. J Hydrol 2006;324:10-23.